

E7C

CIRCULATING COPY
AGRICULTURE LIBRARY

UNIVERSITY OF ILLINOIS
AGRICULTURE LIBRARY

LIBRARY

APR 13 1970

NEW MEXICO STATE
UNIVERSITY

Meat Quality

an explanation
for
educators/processors
retailers/producers

R.G.KAUFFMAN

B.C.BREIDENSTEIN

DONALD GARRIGAN

Q.E.KOLB

Circular 1007

Cooperative Extension Service/College of Agriculture/University of Illinois at Urbana-Champaign
in cooperation with Department of Meat & Animal Science/University of Wisconsin at Madison

CONTENTS

The Complexity of Meat Quality.....	2
Biological Factors Associated With Meat Quality.....	3
Intramuscular fat	3
Connective tissue.....	4
Chronological age.....	4
Texture	5
Firmness	5
Color.....	6
Exudative surface juices.....	8
Rigor mortis.....	8
Nutritional composition	8
Anatomical distribution and position of muscles..	9
Bone darkening.....	10
Nonbiological Factors Associated With Meat Quality..	10
Sanitation	10
Processing.....	10
Packaging and display.....	11
Palatability and the Future of Meat Quality.....	12
References.....	12

THE PURPOSE OF THIS PUBLICATION IS to identify, illustrate, and specifically define the factors associated in some way with variation in quality of meat. The publication is expected to be of particular use to supervisory people in packing plants, merchandising agencies, and meat retailing businesses, to teachers and students of meat science and technology, and to concerned livestock producers.

Quality of meat is vital to the future progress of the meat industry, but there has been widespread misunderstanding of what quality is. The authors define meat quality as *a combination and variation of traits that provide for an edible product that loses a minimum of constituents, is free of spoilage and other abnormalities after processing and storage, is attractive in appearance, and is appetizing, nutritious, and palatable after cooking*. The discussion does not include such traits as high lean-to-fat and lean-to-bone ratios because they are considered quantitative traits, although they are suitable goals in meat production and are often associated with quality.

The discussion applies to beef, lamb, pork, poultry, and veal, except where specifically stated otherwise. A quality factor illustrated for one species usually represents that same factor for other species not specifically shown, although the emphasis placed on each factor may vary among species.

THE COMPLEXITY OF MEAT QUALITY

Appraising meat quality includes consideration of nutritive value, wholesomeness, suitability for processing, palatability, and attractiveness. These factors are interrelated, and each is regulated by biological or physical processes, not all of which are completely understood.

Nutritive value is probably the basic criterion of meat quality. The primary merit of meat as a food is its nutrient content. It has the essential amino acids in the form of muscle proteins; the water soluble vitamins, especially thiamine, riboflavin, and niacin; some minerals, notably iron; and high-energy lipids, including the essential fatty acids. By virtue of the biological nature of muscle tissue, meat supplies most of our nutritive needs for survival.

Wholesomeness refers to the freedom from microorganisms, which is influenced by the health of the animals and by proper sanitation, handling, and storage. Together, nutritive value and wholesomeness satisfy

the minimum requirements for meat to be used as food.

Suitability for processing means that the economic loss from processing can be minimized by holding shrinkage to a minimum through control of such biological mechanisms as muscle acidity and by appropriate heat treatment. Such a product does not always excel in appearance or taste, but usually is above the minimum level of quality.

Palatability characteristics include flavor (a combination of taste and aroma), tenderness, texture, and juiciness. These are controlled somewhat by physiological age and other biological changes.

Attractiveness is an esthetic factor that is primarily influenced by the color and structural appearance of the product and its convenience (such as a boneless product) for use as a food.

The ideal level of meat quality thus combines high nutritive value, wholesomeness, suitability for processing, desirable palatability, and attractiveness.

This publication was prepared by R. G. Kauffman and Q. E. Kolb, Department of Meat and Animal Science, University of Wisconsin at Madison, and B. C. Breidenstein and Donald Garrigan, Wilson and Co., Chicago, Illinois. Kauffman, Breidenstein, and Garrigan developed the circular during their employment at the University of Illinois, Urbana, Illinois

December, 1969

1062 AGX
NO. 1004
COP. 5

BIOLOGICAL FACTORS ASSOCIATED WITH MEAT QUALITY

This section discusses the ways in which several biological factors are related to meat quality: intramuscular fat, connective tissue, chronological age, texture, firmness, color, exudative surface juices, rigor mortis, bone darkening, anatomical distribution and position of muscles, and nutritional composition. Each of these plays some role in the development of a quality product. The authors recognize that more scientific data are needed to fully support some of the following statements.

Recent studies in meat science suggest that such phenomena as ion-protein interactions, quantitative changes in sulfhydryl and disulfide groups within the muscle proteins, changes in intracellular particles (lysosomes in particular), and protein interactions may eventually provide more detailed answers that will explain differences in meat quality. They are not discussed here because there is not enough information to establish a realistic opinion as to how they are specifically related to quality.

Intramuscular fat (primarily a factor in beef, lamb, and pork products)

Quantity. Intramuscular fat (marbling) is the visible fat within the boundaries of a muscle. It usually accumulates as an animal matures and is related to the animal's state of nutrition. A moderate amount of marbling (Fig. 1) is enough to combine with muscle fibers and thus provide a juicy and flavorful cooked product. Too little marbling (Fig. 2) may be responsible for a dry, flavorless product; too much marbling (Fig. 3) does not make the meat proportionately better eating but does increase the caloric intake and thus reduces the protein per unit of edible product (a unit of fat contains about eight times as many calories as a unit of lean muscle).

Distribution and coarseness. Since marbling may enhance juiciness by serving as a lubricant around muscle bundles, it is important that it be uniformly and finely dispersed throughout the muscle as shown in Fig. 1. Large, coarse, and unevenly distributed strands like those in Fig. 4 may represent as much total fat but do not provide enough fat in certain areas of the muscle. Too much fat in some isolated areas may result in an oily taste and more calories than necessary.

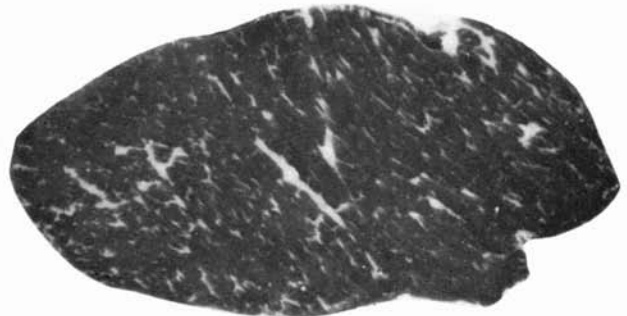


Fig. 1 — Acceptable marbling.



Fig. 2 — Too little marbling.



Fig. 3 — Too much marbling.

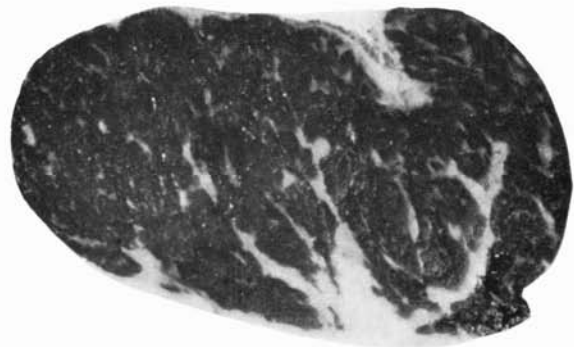


Fig. 4 — Uneven marbling. The lower portion has large, coarse strands of marbling, while the upper left is almost devoid of marbling.

Connective tissue

Muscles with a small proportion of connective tissue are more tender than those with a large proportion. This difference is partly reflected by the anatomical origin of the cut. In the distal portions of the limbs, as shown by the cross-cut shank of beef in Fig. 5, several locomotion muscles converge, each with an increasing proportion of epimysium (connective tissue surrounding the muscle) which blends into tendons attached to the skeleton. This cut would not be as tender as one from a posture control muscle (for example, from the longissimus or psoas muscles of the loin) located in other parts of the carcass. Muscles with less connective tissue are more tender, particularly when the collagen (a protein converted to gelatin upon heating) is high in relation to elastin (a less soluble protein).

Chronological age

The muscles in older animals are generally less tender, even after cooking. The older animals apparently do not have more connective tissue per unit of muscle, but it is believed that advancing age may result in a change in molecular structure and thus in a higher proportion of less soluble connective tissue. To estimate the tenderness it is desirable to know the age. Because the exact chronological age of a carcass is rarely known, it has to be approximated by certain characteristics of the skeleton. Advancing age is accompanied by calcification of the cartilaginous tips (buttons) on the vertical processes (chine) of the thoracic vertebrae and their disappearance from the lumbar and sacral vertebrae, calcification of the hyaline cartilage covering the pubis junction (aitch bone) of the os coxae (pelvis), the straightening of the aitch bone, the fusing of the sacral vertebrae, the absence of blood and hardening of the chine bones, the widening and flattening of the costae (ribs), which are also relatively free of visible blood, and the presence of spools on the foreshanks of lamb. See Fig. 6 for these characteristics and their location.

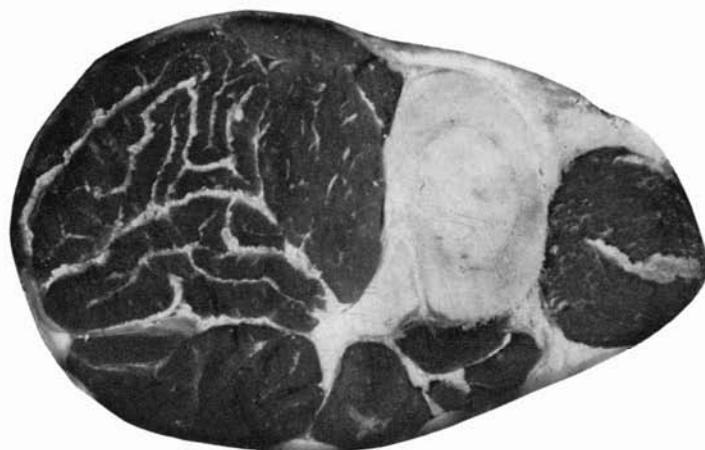


Fig. 5—Cross-section of the shank, showing the heavy white strands of connective tissue that surround each of the muscles and converge toward a tendon.

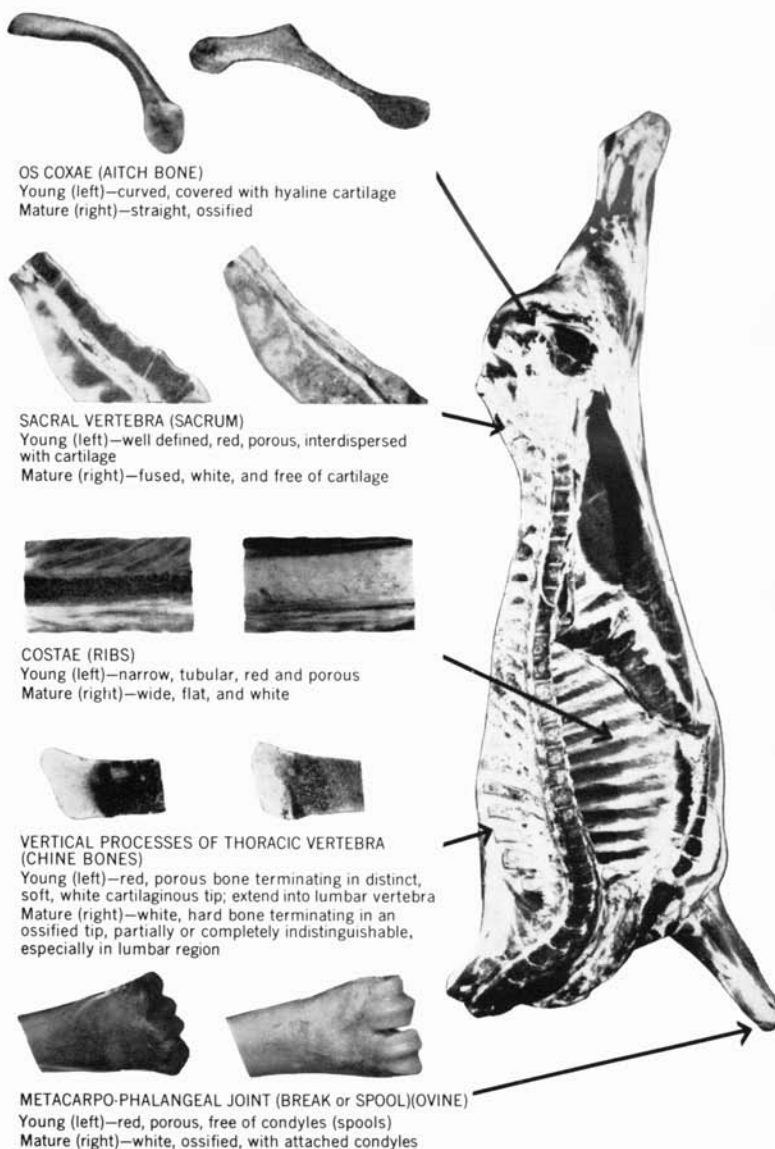


Fig. 6—Skeletal indexes of physiological maturity.

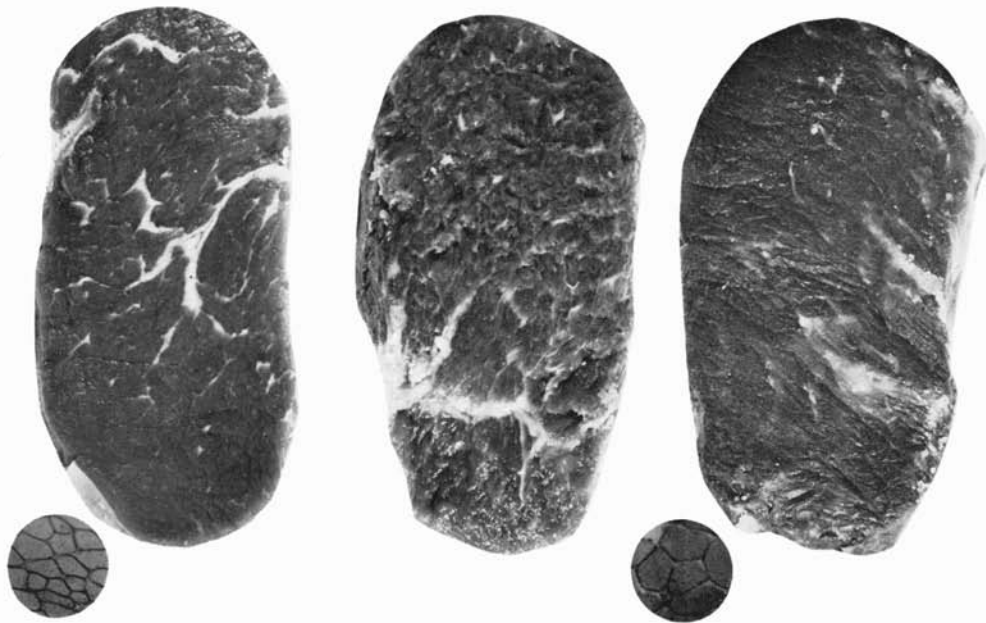


Fig. 7 — At left is relatively smooth texture; at center and right are examples of coarse texture on the surface of muscle. Inserts show sizes of muscle fibers.

Texture

A smooth velvety texture on the cut surface of muscle is more pleasing in appearance and suggests that the meat has come from a young animal and is thus more tender. A rough and coarse texture is undesirable. It may be caused by an increasing thickness of the strands of connective tissue and larger muscle fibers and bundles. (The inset micrographs of Fig. 7 show this.) Rough-appearing texture may also be caused by the softness of an exudative muscle or may result from severe dehydration of a muscle. Examples of smooth and coarse texture are shown in Fig. 7.

Firmness

Muscle. A firm, rigid muscle structure is preferred. A soft muscle or one uneven in firmness generally results from factors that are also responsible for low juice retention and so is considered objectionable. Softness is particularly apparent in pork and may be characterized by severe muscle separation, as shown in Fig. 8. A soft, flabby cut of meat is not attractive and may be rejected by the consumer. However, softness also prevails in muscle originating from young animals containing very little fat (such as veal), and such softness should not be considered objectionable.

Fat. A firm white fat is desirable. Soft, oily fat is usually the result of the animal's diet. Pigs in particular do not have the biological capacity to hydrogenate food stuffs containing a large amount of highly unsaturated fats and so these fats may be deposited directly into adipose tissue. Unsaturated fats are softer at a given temperature and are more susceptible to oxidative rancidity.



Fig. 8 — At top is shown firm, rigid structure of the butt end of a fresh ham. Shown below is a soft structure with pronounced muscle separation.

Color

Muscle. Color in muscle is evaluated by its intensity and by its uniformity.

Greater intensity of color is associated with either higher concentrations of myoglobin (major pigment in muscle) or greater light absorption by the tissue, and may be the result of several phenomena such as:

1. Greater quantities of pigments (myoglobin primarily) as the result of advancing physiological age (beef is darker than veal) or differences between species (lamb is darker than pork).
2. Greater retention of juices.
3. Greater inherent activity or function of the muscle.
4. Smaller quantities of surface oxygen.
5. Greater dehydration of the surface.
6. Microbiological contamination.
7. Lower levels of muscle glycogen as a result of stresses or epinephrine injections before slaughter.

Lower color intensity is usually the result of the reversal of these phenomena.

A light or pale color may indicate that the product

will shrink abnormally during processing, will require a longer time for cooking, and will not be juicy after cooking. A dark color may suggest an older (physiologically) or dehydrated product that may be less tender and less attractive. Such extreme variations in muscle color as shown in Figs. 13 and 14 are therefore usually objectionable.

A light color is also an indication of youthfulness (such as veal as compared with beef), but it is sometimes difficult to differentiate an acceptable youthful color from one that may be related to water-holding capacity. Inherent colors are different for each species and for individuals within a species; desirable colors are shown in Figs. 9, 10, 11, 12, and 16.

Most muscles are relatively uniform in color (one exception is the semitendinosus) but extreme variation often occurs between muscles closely associated anatomically, especially in pork. The two-toned appearance shown in Fig. 13 is undesirable for several reasons: Consumers may object to its appearance; the appearance indicates that two-toning may persist in other anatomical locations in the carcass and may persist after processing (curing); and the pale, soft,

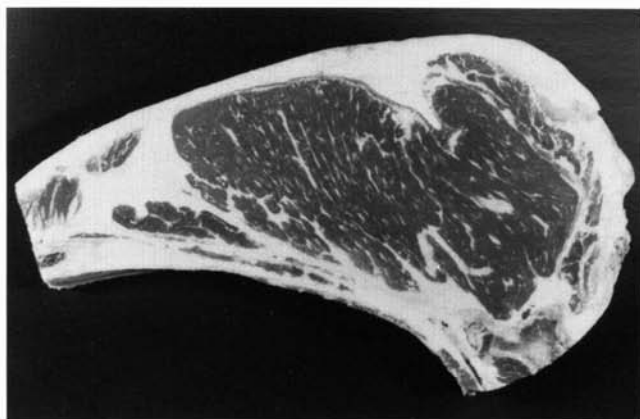


Fig. 9 — Desirable color for beef, bright red.



Fig. 10 — Desirable color for veal, grayish pink.

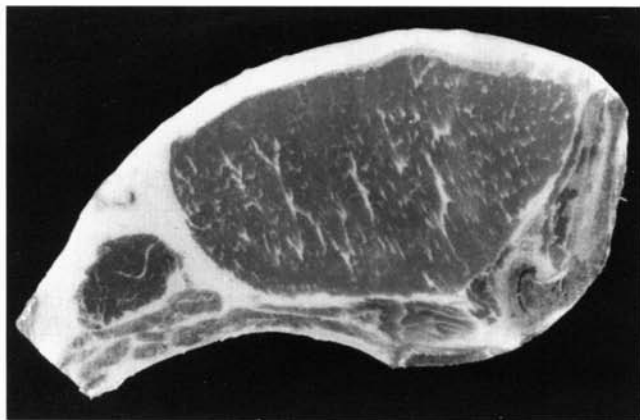


Fig. 11 — Desirable color for pork, reddish pink.

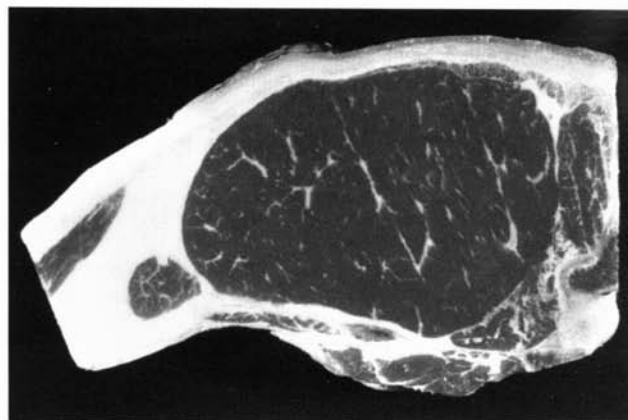


Fig. 12 — Desirable color for lamb, purplish red.

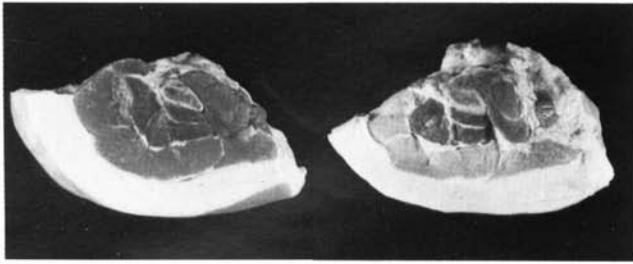


Fig. 13 — The gluteal muscles of the left ham are uniformly colored in a desirable way and those of the right ham are not.

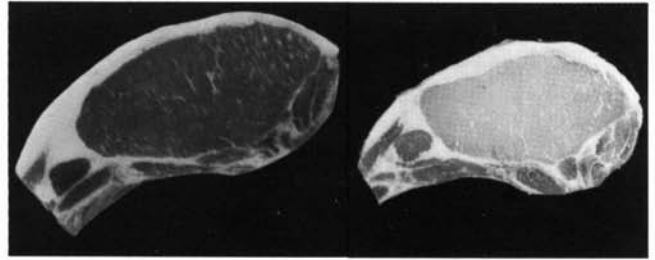


Fig. 14 — Example of extreme variation in color intensity of muscles from two different pork loins.

exudative (pse) nature of the lighter-colored muscle (gluteus medius) is in itself undesirable.

Fat. Variation in fat color from white to a yellow-orange is the result of the accumulation of carotene (as well as of other plant pigments), which occurs in ruminants consuming excess quantities of plant carotenes or in those animals unable to metabolically convert them to vitamin A. Different colors of fat are not nutritionally objectionable; yellow fat, however, contains a greater proportion of unsaturated fatty acids, which are more susceptible to oxidative rancidity, and some consumers may object to yellow fat because they associate it with older animals. However, some young animals fed only grass or forages may also have yellow fat. Five degrees of color of subcutaneous fat are shown in Fig. 17.



Fig. 15 — Example of dark cutting beef (note the coarse marbling in this example).

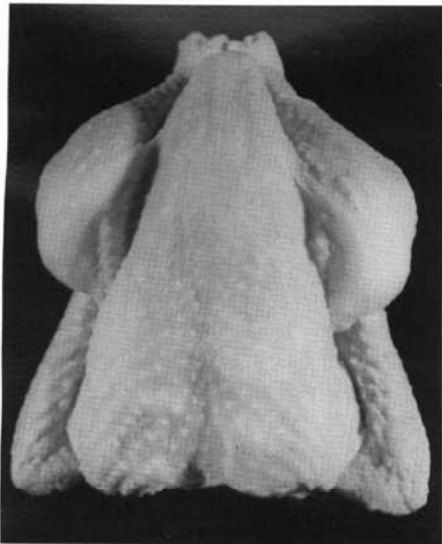


Fig. 16 — Desirable color for poultry, bright, light yellow.

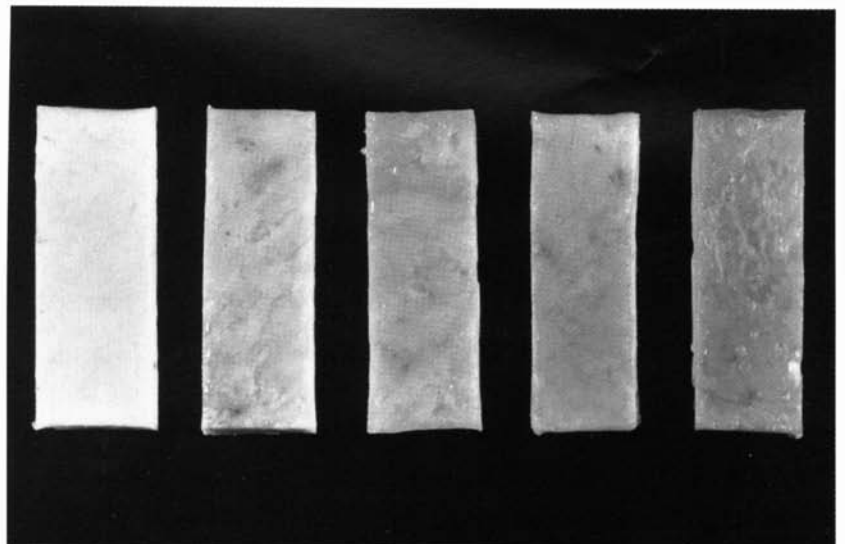


Fig. 17 — Variations of color that may exist in beef fat.

Exudative surface juices

Surface juices result from changes in the water-holding capacities of muscle proteins and of other biological entities. These juices may lend brightness to a freshly cut surface, but should be considered objectionable because they are responsible for abnormal shrinkage and loss of water-soluble nutrients during cookery (especially dry heat) and processing, resulting in a dry, less palatable, and less nutritious product.

Differences in amounts of exudative juices are shown in Figs. 18 and 19. Variation of this kind is most prevalent in pork.

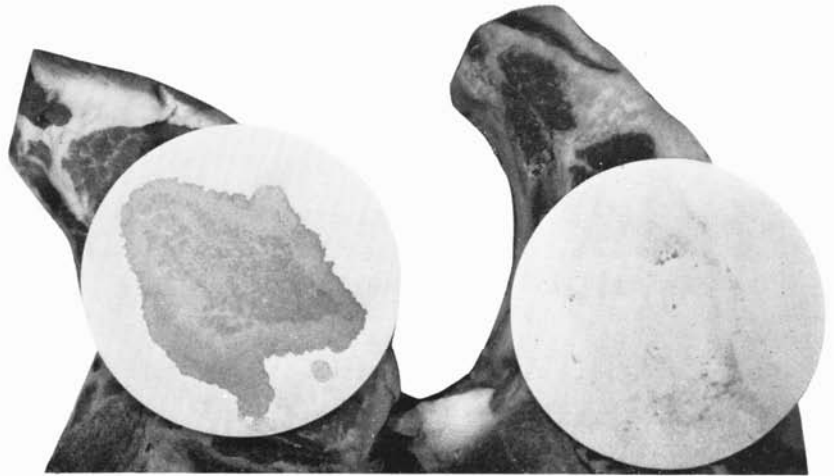


Fig. 18 — The pale, soft, exudative (pse) pork muscle at left shows an abnormally high quantity of free juices absorbed by filter paper. The paper on the dark, firm, and dry (dfd) muscle (right) shows little absorption.

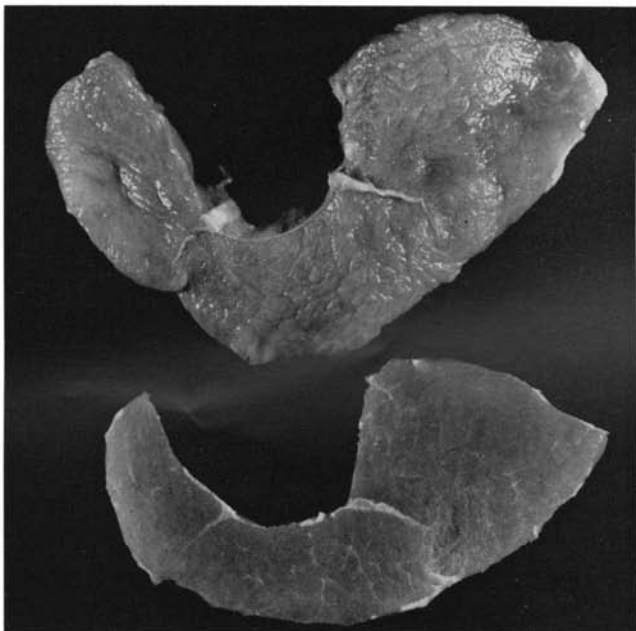


Fig. 19 — The slice of gluteus medius muscle from the butt end of a ham, at top, shows an excessive quantity of surface juices, compared with the more desirable dry surface of the one below.

Rigor mortis

After an animal is slaughtered, muscles undergo a number of biochemical changes that contribute to the physical and chemical properties of muscle sometimes referred to as onset, climax, and softening stages of rigor mortis. How long each stage lasts depends on the species, environmental conditions (such as temperature), ante-mortem and post-mortem biochemical properties of each muscle, and other biological phenomena, not all of which are understood.

As a muscle goes into rigor mortis, it stiffens, which usually results in extreme toughness and a reduction in the water-holding capacity of the muscle proteins. Both before and after the climax of rigor mortis, the muscle fibers are softer and thus more tender and acceptable for eating. They also retain a greater proportion of their juices. Time is a good index to the stage of rigor mortis.

Rigor mortis is rarely of concern under present market conditions because processing time before consumption usually exceeds the time required for a muscle to pass through the stages of rigor mortis. If lamb muscle is rapidly chilled early post mortem before onset of rigor mortis, fiber shortening may occur and impair tenderness. This effect is known as cold shortening. If a muscle is frozen in the pre-rigor state, it will complete the rigor mortis cycle after thawing. This is known as thaw-rigor.

Nutritional composition

Meat is an excellent source of protein. Contractile proteins supply desirable quantities of all the essential amino acids, but meat that contains relatively large amounts of connective tissue proteins will provide smaller proportions of several essential acids, particularly tryptophan, methionine, and histidine. Meat is also a good source of some vitamins and minerals, the essential fatty acids, and calories. However, it is deficient in calcium and in vitamin A, C, and D (except for liver).

The table on page 9 compares the nutrient composition of a 100-gram cooked portion of different kinds of meat with recommended nutrient allowances.

Table 1. — Nutrient Content of Meat

	Nutrient content of a 100-gram cooked portion								Daily nutrient allowances recommended by the National Research Council				
	Beef lean	Beef lean + mar- ble	Veal	Lamb	Pork	Cured pork	Liver (beef)	Poul- try (light + dark mus- cles)	Men	Women	Pregnant women	Youth	Small child
	(8% fat)	(15% fat)	(5% fat)	(7% fat)	(7% fat)	(10% fat)			(18-35 yr.)		(18-35 yr.)	(9-18 yr.)	(3-6 yr.)
Calories.....	209	266	192	188	194	225	229	171	2,900	2,100	2,300	2,633	1,600
Protein, g.....	32	30	34	29	31	32	26	30	70	58	78	66	40
Vitamins													
Thiamine, mg.....	.11	.10	.21	.21	1.18	.78	.26	.05	1.2	.8	1.0	1.1	.6
Riboflavin, mg.....	.33	.31	.32	.33	.19	.16	4.19	.16	1.7	1.3	1.6	1.6	1.0
Niacin, mg.....	5.6	5.7	7.1	7.9	5.5	5.3	16.5	8.6	19.0	14.0	17.0	17.5	11.0
Pantothenic acid, mg.....	.41	.47	.50	.59	.40	.57	7.30	.90	NE	NE	NE	NE	NE
Pyridoxine, mg.....	.54	.50	.43	.33	.48	.63	.74	NA	2.0	2.0	NE	2.5	.5
B ₁₂ , mcg.....	2.2	2.1	2.7	2.4	1.1	1.7	65.0	NA	5.0	5.0	NE	NE	NE
A, I.U.....	0	0	0	0	0	0	53,500	0	5,000	5,000	6,000	4,800	2,500
C, mg.....	0	0	0	0	0	0	31	0	70	70	100	80	50
D, I.U.....	10	NA	10	10	10	NA	45	10	NE	NE	400	400	400
Minerals													
Calcium, mg.....	9.4	8.4	8.5	8.2	12.1	15.5	11.0	12.0	800	800	1,300	1,270	800
Iron, mg.....	3.1	3.0	3.2	1.3	3.8	4.1	8.8	1.5	10	15	20	15	10
Magnesium, mg.....	23	21	22	24	24	30	18	19	NE	NE	NE	NE	NE
Phosphorus, mg.....	202	191	267	234	242	266	476	247	NE	NE	NE	NE	NE
Potassium, mg.....	461	493	475	485	568	567	380	366	NE	NE	NE	NE	NE
Sodium, mg.....	42.8	41.8	66.3	82.9	59.6	1,974.0	184.0	75.0	NE	NE	NE	NE	NE
Fatty acids.....	Lipid portions of meat, especially pork, are fair sources of the essential fatty acids; however minimum dietary requirements have not been established.												

NE = not established, NA = information not available.

Anatomical distribution and position of muscles

Muscles such as the longissimus of the loin are more palatable than others simply because of their physiological function and physical location.

Posture-control muscles are more tender because they have less connective tissue and because they may not contract as much as muscles used for locomotion.

Shape of the animal appears to influence to some degree the proportions of desirable and undesirable cuts of meat (judged by palatability and convenience in use). In general, carcasses that have large desirable muscles (pelvic limb muscles, thoracic and lumbar muscles) will also have large less desirable muscles. However, a greater proportion of desirable muscles grow faster during the earlier stages of growth and have increased hypertrophy and more fibers per muscle than some of the less desirable muscles. The two carcasses in Fig. 20 are similar in size, but the proportion of muscle mass in the more desirable locations may be higher in the example on the left.

Furthermore, the position in which a carcass is chilled after slaughter and whether muscles have been cut free from their skeletal attachments will affect their desirability. Muscles that are stretched as a result of carcass positioning will have longer sarcomeres and will probably be more tender than those that have been permitted to shorten as a result of carcass positioning or because of severing from their skeletal supports.



Fig. 20. — Carcass at left is thickly muscled. Carcass at right is thinly muscled.

Bone darkening (poultry)

The bones and adjacent muscles in poultry may discolor when young broilers (under 16 weeks old) are frozen and then thawed. The freezing and thawing liberates hemoglobin (soluble pigmented protein) from the bone marrow, which leaches through the young, spongy wall of the bone and is deposited on the outside (mature bones have enough minerals deposited to prevent this). Cooking oxidizes and denatures the hemoglobin, changing its red color to various shades of brown. Freshly dressed broilers held for more than 48 hours will also discolor and the discoloration becomes more severe as holding time increases.

Cooking poultry before freezing coagulates the hemoglobin and prevents the leaching process. Freezing and storing at -20°F . will also prevent additional discoloration. Three degrees of darkening are shown in Fig. 21. The condition is not related to diseases or improper processing techniques.

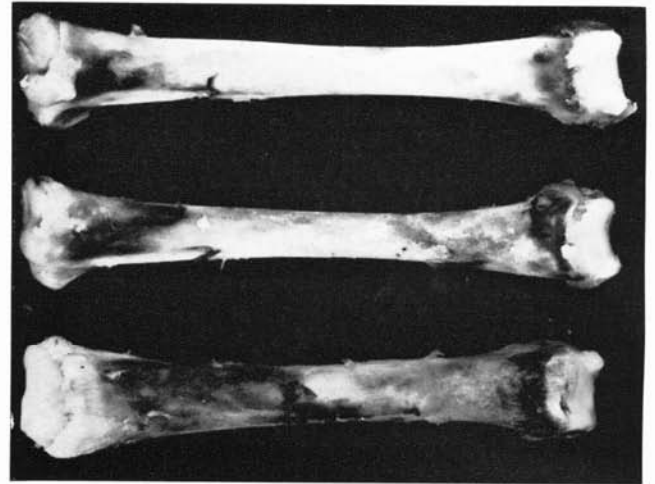


Fig. 21 — Darkening of leg bones (tibia) of poultry after cooking; from top to bottom, very slight, moderate, and severe.

NONBIOLOGICAL FACTORS ASSOCIATED WITH MEAT QUALITY

Several nonbiological factors may indirectly affect the quality of meat, especially fresh meat, and its acceptance by the consumer. Adequate sanitation, correct processing, and proper packaging and display are discussed here because they have the greatest effect.

Sanitation

Meat should be wholesome—clean and free from spoilage. The health of the animal and the conditions of sanitation under which the product is handled should insure this. Sanitation is usually satisfactory and normally does not need to be considered a quality factor, but contaminated meat has been responsible for many undesirable characteristics that alter the appearance and taste because of spoilage. Such contamination results from ignoring the fundamentals of sanitation or from careless practices.

The importance of good sanitation is illustrated in Fig. 22.

Processing

Processing includes any techniques applied to meat in order to bring about physical or chemical changes. Some processing techniques enhance palatability, while others serve only to preserve the product. Usually the overall quality is improved, but processing may reduce the desirability of some quality factors—for example,

grinding improves tenderness but more nutrients and water are lost because of the greater surface area.

The table at the top of the next page represents the authors' views about some probable effects of accepted processing techniques on the quality characteristics of meat. The processing effects do not apply to all meats and some processing-quality relationships are questionable. The generalizations assume adequate sanitation, correct use of additives, standardized processing techniques, and no use of drippings from the cooked product. Appearance is judged immediately after exposure to type of processing (except for additives). Changes in nutritional composition refer to a quantitative change in each of the components.

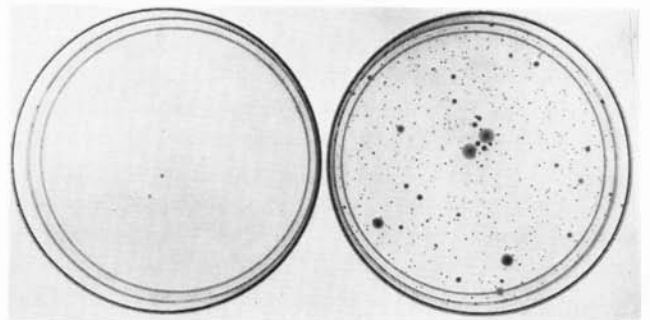


Fig. 22 — Growth of microorganisms under good (left) and poor (right) sanitary conditions.

Table 2. — Probable Relationships Between Processing and Meat Quality

	Appearance	Palatability				Nutritional composition (see Table 1)					Wholesomeness as a result of processing
		Flavor	Tender-ness	Juici-ness	Texture	Proteins and free amino acids	Fat	Mois-ture	Min-erals	B vita-mins	
Heating											
Short time, dry heat (10 min. per lb.), high temp. (more than 400° F.)	+	+	—	—	+	—	—	—	—	—	+
Long time, moist heat (30 min. per lb.), low temp. (350° F.)	+	+	+	0	?	—	—	—	—	—	+
Irradiation	0	—	0	0	0	0	0	0	0	—	+
Freezing											
Sharp (—30° F.)	—	0	0	0	0	0	0	0	0	0	+
Slow (0° F.)	—	0	0	—	—	—	0	—	—	—	+
Freeze-drying	—	—	0	—	—	0	0	—	0	0	+
Drying	—	?	—	—	—	—	0	—	—	—	+
Aging (post mortem)	—	?	+	0	0	0	0	0	0	0	?
Cutting, grinding, chopping, or cubing	?	0	+	—	+	—	0	—	—	—	—
Additives											
Salt	0	+	0	+	0	0	0	?	0	0	+
Nitrates and nitrites	+	0	0	0	0	0	0	0	0	0	+
Phosphates	?	0	0	+	+	0	0	+	0	0	+
Seasonings	?	+	0	0	0	0	0	0	0	0	0
Binders	+	0	0	+	+	+	0	+	+	+	0
Smoke	+	+	0	0	0	0	0	0	0	0	+
Enzymes	0	?	+	0	+	0	0	0	0	0	0
Sugar	0	+	0	0	0	0	0	0	0	0	0
Ascorbates	+	0	0	0	0	0	0	0	0	0	+

+ = desirable effect (greater retention for nutritional composition); 0 = no change; — = potential detrimental effect; ? = questionable or unknown.

Packaging and display

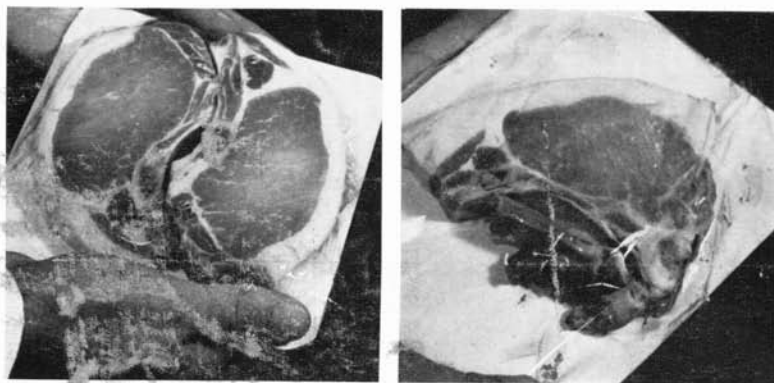
The method of displaying meat and the container in which it is displayed are not exactly quality factors but are closely associated with the acceptance of a meat product. To receive maximum acceptance, a meat product should be free of bone and excess fat and should be formed into an appropriate shape and size so that it will be convenient and attractive to look at, cook, and serve. The meat should be contained in packaging material that permits maximum visibility and storage life, retains a desirable color, and prevents abnormal shrinkage. Figs. 23 and 24 show desirable and undesirable methods of packaging a beef roast and pork chops.

Fig. 23 — The blade roast at the bottom has not been trimmed of excess fat (A); and the bone (B); seam (intermuscular) fat (C); and backstrap (ligamentum nuchae) (D) have not been removed. The cut is too large and improperly shaped for convenient cooking and serving. The cut at top originated from a similar anatomical location but it has been trimmed, boned, rolled, and tied to provide a desirable roast.

Correct lighting should be used to enhance the appearance of color and freshness of the product. Lighting can be supplemented by complimentary backgrounds such as green, white, or black, but orange or pink will detract from the effect. Lighting should be used that will minimize heat production in the refrigerated display case.



Fig. 24. — Examples of desirable and undesirable packaging. At left, the transparent wrapping material is snugly and smoothly stretched over carefully prepared cuts that precisely fit the small display board. At right the loose and wrinkled wrapping material is only partly sealed around the oversized and smudged display board and the cut is untrimmed and poorly shaped. The cut at the right will dehydrate, discolor, and spoil more rapidly than the cuts at the left.



PALATABILITY AND THE FUTURE OF MEAT QUALITY

Since people purchase meat primarily for its taste appeal, an appropriate palatability level should be maintained. Improvement of palatability through production methods, however, is an expensive process. High levels of palatability partly result from high levels of feeding over an extended period of time, and the gains produced under such conditions are produced at an increased cost and an increased proportion of these gains consists of fat. But American consumers prefer lean meat. The time in physiological development at which quality has reached the desired level and excess fat has been minimized is of major concern.

Will palatability be increased in the future? Since palatability may be related to the genetic background of the animal, there is a genetic potential to change palatability levels. Such changes can be either positive or negative, but in either event will be slow.

The authors believe that the entire meat industry should be concerned with improving levels of palatability. It is probable that advances in the understanding of the biological mechanisms and technological developments in processing that are related to palatability will result in means of improving and standardizing meat quality.

REFERENCES

- American Meat Institute Foundation. The science of meat and meat products. W. H. Freeman & Co., San Francisco, Calif. 1960.
- Blumer, T. N. Relationship of marbling to the palatability of beef. *Journal of Animal Science* 22:771. 1963.
- Bray, R. W. Pork quality — definition, characteristics and significance. *Journal of Animal Science* 25:839. 1966.
- Briskey, E. J. Etiological status and associated studies of pale, soft, exudative porcine musculature. Pages 90-168 in C. O. Chichester, E. M. Mrak, and G. F. Stewart (ed.), *Advances in Food Research*, Academic Press, New York. 1964.
- Briskey, E. J., R. G. Cassens, and J. C. Trautman. The physiology and biochemistry of muscle as a food. University of Wisconsin Press, Madison. 1966.
- Burton, B. T. The Heinz handbook of nutrition. McGraw-Hill Book Co., New York. 1965.
- Campbell Soup Co. Proceedings, flavor chemistry symposium. Camden, New Jersey. 1961.
- Campbell Soup Co. Proceedings, meat tenderness symposium. Camden, New Jersey. 1963.
- Cassens, R. G., and R. W. Bray. Meat quality estimation methods. *Z. für Tierzüchtung und Züchtungs-biologie* 82:286. 1966.
- Composition of Foods. Agriculture Handbook No. 8. Agricultural Research Service, U.S. Department of Agriculture, Washington, D. C. 1963.
- Cooper, C. C., B. B. Breidenstein, R. W. Bray, and R. G. Cassens. Investigations to determine the influence of marbling upon the tenderness and juiciness of beef differing in maturity. A final report to USDA Market Quality Research Division. 1967.
- Hamm, R. Biochemistry and meat hydration. Pages 356-484 in C. O. Chichester, E. M. Mrak, and G. F. Stewart (ed.), *Advances in Food Research*, Academic Press, New York. 1960.
- Irving, G. W., Jr., and S. P. Hoover. Food quality effects of production practices and processing. Publication No. 77, American Association for the Advancement of Science, Washington, D. C. 1965.
- Lawrie, R. A. Meat science. Pergamon Press, New York. 1966.
- Leverton, R. M., and G. V. Odell. The nutritive value of cooked meat. Oklahoma Agricultural Experiment Station MP-49. 1958.
- Marsh, B. B., P. R. Woodhams, and N. G. Leet. Studies in meat tenderness. 5. The effects on tenderness of carcass cooling and freezing before the completion of rigor mortis. *Journal of Food Science* 33:12. 1968.
- National Academy of Sciences—National Research Council. Evaluation of protein nutrition. Publication 711, Washington, D. C. 1959.
- National Research Council. Recommended dietary allowances. 6th revised edition. Publication 1146, National Academy of Sciences, Washington, D. C. 1964.
- Pearson, A. M. Desirability of beef — its characteristics and their measurement. *Journal of Animal Science* 25:843. 1966.
- Sherman, W. C., director of nutrition research, National Live Stock and Meat Board. Personal communication. 1968.
- Szczesniak, A. S., and K. W. Torgeson. Methods of meat texture measurement viewed from the background of factors affecting tenderness. Pages 33-139 in C. O. Chichester, E. M. Mrak, and G. F. Stewart (ed.), *Advances in Food Research*, Academic Press, New York. 1965.
- Waisman, H. A., and C. A. Elvehjem. The vitamin content of meat. Burgess Publishing Co., Minneapolis, Minnesota. 1941.
- Yeates, N. T. M. The definition and measurement of meat quality—Tenderness. In *Modern Aspects of Animal Production*, p. 187. Butterworths Publications Ltd., London. 1965.